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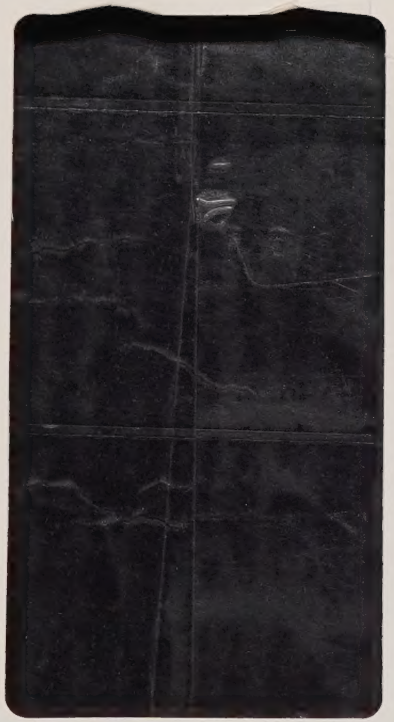

INSTRUCTION MANUAL

MODEL 110
WIDEBAND AMPLIFIER

MODEL 111
PULSE AMPLIFIER

WARRANTY

We warrant each of our products to be free from defects in material and workmanship. Our obligation under this warranty is to repair or replace any instrument or part thereof (except tubes and batteries) which, within a year after shipment, proves defective upon examination. We will pay domestic surface freight costs.

To exercise this warranty, call your local field representative or the factory, DDD 216-795-2666. You will be given assistance and shipping instructions.

REPAIRS AND RECALIBRATION

Keithley Instruments maintains a complete repair service and standards laboratory in Cleveland, and has an authorized field repair facility in Los Angeles.

To insure prompt repair or recalibration service, please contact your local field representative or the plant directly before returning the instrument.

Estimates for repairs, normal recalibrations, and calibrations traceable to the National Bureau of Standards are available upon request.

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* Yellow Change Notice sheet is included only for instrument modifications affecting the Instruction Manual.

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SECTION 1. GENERAL DESCRIPTION

1-1. GENERAL. The Keithley Models 110 and 111 are small high-impedance unity-gain amplifiers with complete solid-state circuitry. They are designed for use where impedance matching or cable driving capability is desired. The Model 110 is tuned for a wideband frequency response; the Model 111 is tuned for pulse response. (See Figures 9 and 10 for illustrations of the two responses.) Both Models require an external power supply, preferably the Keithley Model 1081 Power Supply.

a. The Model 110 bandwidth is from 500 cps to 180 Mc (-3 db). Response from 1 kc to 150 Mc is flat ±0.5 db. Voltage gain is 1 (0 db) when terminated into a 50-ohm load. The input impedance is 10 megohms, 12 picofarads. This Amplifier can be used directly with higher impedance systems without power or voltage losses.

b. The Model 111 Pulse Amplifier has a rise time of less than 3 nanoseconds (10% to 90%). Overshoot is less than 3%, pulse width for a 10% droop is 40 microseconds. Other specifications are the same as for the Model 110.

1-2. MODELS 110, 111 DIFFERENCES.

a. The Models 110 and 111 differ only in their tuning. Their circuits and parts are identical. Most of the Instruction Manual applies to both units. Where there are differences — such as applications and calibration — the models are identified.

b. Specifications and operations in this Manual assume using the Keithley Model 1081 Power Supply or Models 106 and 107 to power the Amplifier. It is recommended that these be used to obtain the maximum benefit from the Amplifier.

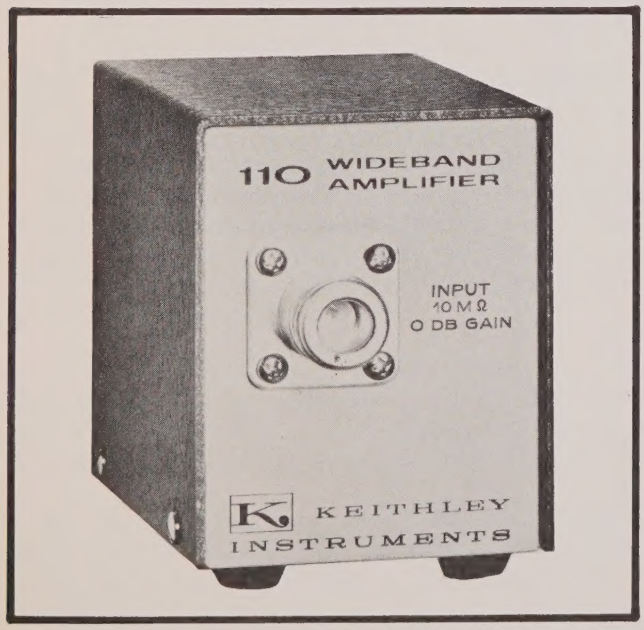


FIGURE 1. Keithley Instruments Model 110 Wideband Amplifier.

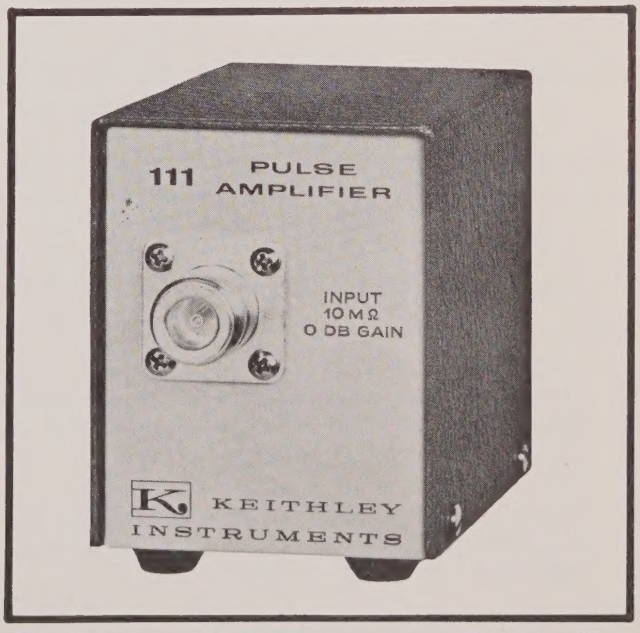


FIGURE 2. Keithley Instruments Model 111 Pulse Amplifier.

1-3. SPECIFICATIONS.

Model	Model 110 (when powered by the Model 1081 Power Supply)	Model 111 (when powered by the Model 1081 Power Supply)
Frequency: -3 db ±0.5 db	500 cps and 180 Mc 1 kc to 150 Mc	-- --
Rise Time 10% - 90%	Less than 3 nanoseconds	Less than 3 nanoseconds
Overshoot	--	Less than 3%
Pulse Width for 10% Droop	--	40 microseconds
Input Impedance	10 megohms, 12 picofarads	10 megohms, 12 picofarads
Voltage Gain[1]	1 (0 db) ±2% at 10 kc	1 (0 db) ±2% at 10 kc
Maximum RMS Noise[1,2]	75 microvolts (12 db)	75 microvolts (12 db)
Maximum Output[1]	700 millivolts peak-to-peak	700 millivolts peak-to-peak
Maximum Input Overload[3]	ac, 300 volts peak-to-peak dc, 600 volts	ac, 300 volts peak-to-peak dc, 600 volts
Maximum Output With Overload[1]	2 volts peak-to-peak	2 volts peak-to-peak
Overload Recovery[4]	Less than 50 nanoseconds	Less than 50 nanoseconds
Delay Time	Less than 5 nanoseconds	Less than 5 nanoseconds
Line Stability	Change in output amplitude less than ±0.1% for a 10% line voltage change	
Cable Driving Ability	By re-tuning, the above specifications can be duplicated at the end of 100 feet of cable (Belden RG 8/U polyfoam) except for maximum output which is reduced to 500 millivolts peak-to-peak and added delay time. (See paragraphs 5-7 and 5-8.)	

NOTES:

1) Into a 50-ohm characteristic impedance.
2) Noise referred to input measured from 10 cps to 100 Mc.
3) AC overload continuously applied, DC overload applied continuously in either polarity or applied as a step function.
4) Using a 100x overload test pulse 100 nanoseconds wide with 5-nanosecond fall time to within 1% of base line. A shorter pulse duration, a slower fall time or less overload shortens recovery time.

CONNECTORS: Input and Output: n type. Power: Amphenol 126-214.

POWER: +16 volts dc and -12 volts dc or 28 volts dc floating; ±5% accuracy; ±0.1% stability;

40 milliamperes current (1 watt); 2 millivolts peak-to-peak maximum ripple; 100 microfarad filter from each power terminal to ground.

DIMENSIONS, WEIGHT: 3 inches high x 2-1/4 inches wide x 3-3/4 inches deep; net weight, 12 ounces.

ACCESSORIES SUPPLIED: Model 1083 Power Cable; POWER mating connector; 2 n-type mating connectors.

1-4. APPLICATIONS.

a. The Models 110 and 111 increase the usefulness of Keithley 50-ohm amplifiers by providing high input impedance and overload protection. They allow the Models 106, 107, 108 and 109 Amplifiers to be used with a variety of characteristic impedances for voltage amplification up to 1000.

b. Since their high input impedance has a very low circuit loading effect, the Models 110 and 111 are particularly useful in amplifying signals from high impedance sources such as photomultiplier tubes. Both Amplifiers permit instruments with 50-ohm inputs to be used with higher impedance systems without power or voltage losses. Input feed-through terminations for 75 and 93-ohm systems are available in the Model 1041 Accessory Kit (Section 6).

c. Both Amplifiers will withstand continuous overloads of 300 volts peak-to-peak ac and 600 volts dc. Maximum output under overload conditions is limited to 2 volts peak-to-peak, providing input protection for other 50-ohm instruments such as sampling oscilloscopes.

d. The Models 110 and 111 are ideal for general laboratory use or installation in systems. Both may be mounted in any advantageous position with the 1082 Mounting Plate.

e. Either Model may be located at the signal source to minimize capacitive loading of the source. These Amplifiers are capable of being tuned to compensate for cable losses up to 2.5 db at 200 megacycles. This permits a signal source to be located up to 100 feet from a system without signal loss.

f. Other applications include use with mass spectrometers, high speed counters, thermopiles and infrared detectors.

1-5. ACCESSORIES. Refer to Section 6 for complete descriptions of the following Amplifier accessories.

a. Model 1081 Power Supply can power one, two or three Model 110 or 111 Amplifiers. The Power Supply operates from 105-125 or 210-250 volts, 50-400 cps line sources; power rating is 12 watts. Its dimensions are the same as the Amplifiers; net weight is 1-1/2 pounds.

b. Models 1041 and 1042 Accessory Kits provide useful adapters, terminations, high-pass filter and tee for use with the Amplifiers. The accessories, contained in a convenient case, are described in Section 6.

c. Model 1082 Mounting Plate adapts the Amplifiers and the Model 1081 for mounting to another surface.

d. Model 1083 Power Cable, 3 feet long, connects the Model 110 or 111 to the Keithley Models 106 and 107 Amplifiers or to the Model 1081 Power Supply.

1-6. EQUIPMENT SHIPPED. The Models 110 and 111 are factory-calibrated and are shipped with all components in place. All units are shipped for bench use. The shipping carton contains the Instruction Manual, Model 1083 Power Cable and mating power connector and input and output plugs.

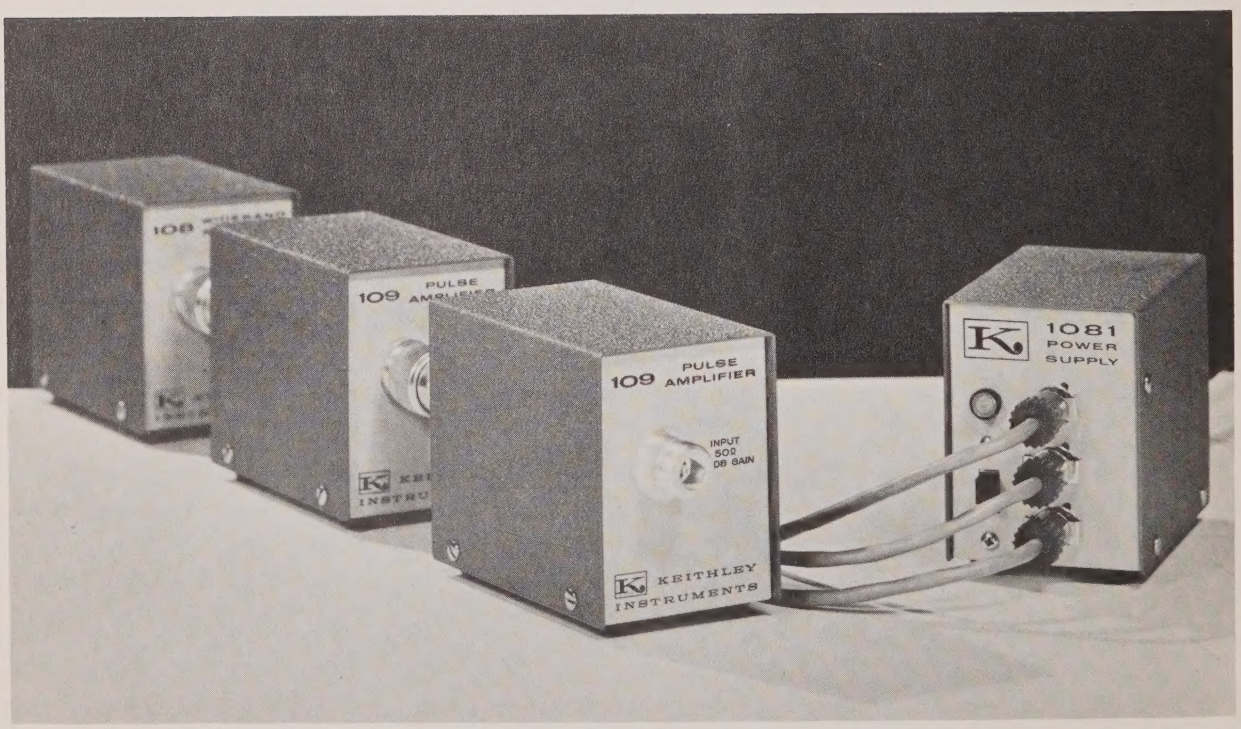


FIGURE 3. Model 1081 Power Supply Used with Three Keithley Amplifiers. The Supply will power one, two or three Models 108, 109, 110 or 111 Amplifiers. See Section 6 for the Power Supply description.

SECTION 2. OPERATION

2-1. TERMINALS.

a. INPUT and OUTPUT Receptacles. INPUT (front panel) and OUTPUT (rear panel) Receptacles are n-type. Input impedance is 10 megohms, 12 picofarads. N-type connectors are used for their better impedance characteristics and less leakage at higher frequencies than other popular connectors.

b. POWER Socket. The POWER Socket is a 4-pin connector, which mates with the connectors on the Model 1083 Power Cable. Schematic Diagram 18739D shows the pin connections and voltages (referred to J103).

2-2. CABLE CONNECTIONS.

a. Use coaxial cables for connections, especially if working above 1 Mc. The Amplifier may have up to six feet of coaxial cable on the input and up to 12 feet on the output, if the output cable is terminated with 50 ohms, without requiring retuning.

b. By retuning the Amplifier to make up for cable loss, up to 100 feet of cable may be used on the output without loss or degradation of response characteristics. This allows locating the Amplifier at the signal source to minimize capacitive loading of the source.

1. Recommended cable is Amphenol or Belden polyethylene cable (RG8/U) rated at 50 ohms and having 29.5 picofarads/foot. The type of cable used is especially important to obtain the maximum distance.

2. The furnished mating output connector will not fit the above cable. A suitable connector is UG21B/U or its equivalent.

3. Refer to paragraph 5-7 for retuning the Model 110 and to paragraph 5-8 for retuning the Model 111. After retuning, operate the Amplifier as described below.

2-3. OPERATING PROCEDURES.

a. No control settings or preliminary adjustments are needed to operate either Amplifier. Both can be used immediately after they are connected to the Model 1081 Power Supply or an equivalent supply. When used with the Keithley Model 106 or 107 Amplifier, connect the unity-gain amplifier to the Pre-amplifier Power Receptacle on the rear panel.

NOTE

The Amplifiers have n-type receptacles (Mil. No. 680/U). The Models 1041 and 1042 Accessory Kits contain adapters to connect other type plugs to the Amplifier. Section 6 describes the Kits.

b. Connect the Power Supply and associated equipment, such as an oscilloscope, on the same power line to avoid ac ground loops. Otherwise, the output signal from the Amplifier may tend to be modulated by the ground loops. To further minimize ground loops, it may be necessary to use isolation plugs on power line plugs of the Power Supply and the associated equipment. If a power supply other than the Model 1081 is used, put 100-microfarad filter capacitors from the positive and negative outputs to ground.

c. If low-frequency response is not desired, use the high-pass filter (-3 db at 10 kc) from the Model 1041 Accessory Kit on the amplifier output. This will reduce amplifier noise by at least 20%.

2-4. CASCADING. The Models 110 and 111 increase the usefulness of other Keithley amplifiers. They allow the Models 106, 107, 108 and 109 Amplifiers to be used with a variety of characteristic impedances. This allows signal amplification of X10, X100, or X1000 from sources which have other than 50-ohm impedance with no loss. An n-type male-to-male adapter, available in the Model 1042 Kit (Section 6), readily allows cascading.

2-5. OPEN CIRCUIT OPERATION. The specified amplifier gain is into a 50-ohm load. The gain changes for an open circuit. Output impedance is approximately 75 ohms at 10 megacycles, increasing somewhat at high frequencies. The gain into an open circuit is approximately 2.25 (7 db). The amplifier will not oscillate into an open circuit at any frequency, although standing waves become apparent at the higher frequencies. The magnitude of the waves depends directly on cable length and frequency.

2-6. AMPLIFIER NOISE. The main sources of noise are the transistors and any power supply ripple. Since all noise is referred to the input, the output noise will be the amplifier input noise times the amplifier gain (1). The noise is measured at the output and referred back to the input. When two Amplifiers are cascaded, the noise of the second amplifier is not significant because noise adds as the square root of the sum of the squares.

2-7. RISE TIME.

a. The rise time is defined as the time needed for a signal to rise from 10% to 90% of its final value. Specifically, for amplifiers, rise time is the time needed for the amplifier to go from 10% to 90% of the final value of the input signal times the amplifier gain. Rise time is measured only with a pulse whose rise time is faster than the amplifier's. When amplifiers are cascaded, the rise times add in quadrature (square root of the sum of the squares).

b. The slight overshoot of a very high frequency pulse can be eliminated in the Model 110 by detuning the high-frequency response slightly. The Model 110 is tuned for maximum gain flatness for a continuous signal. The Model 111 is already tuned for minimum overshoot.

2-8. DELAY TIME. Delay time is the transit time taken by a signal to go from the amplifier input to output. Because delay times are a physical constant, they add for cascaded amplifiers.

2-9. GROUND LOOPS. A common source of errors when amplifying low-level signals is ground loops. This is a current — line or other frequency — flowing in a ground lead impedance, which results in a voltage in addition to the desired signal voltage appearing at the input terminals of the amplifier. Although the origin and mechanism of ground loops are difficult to explain and trace, their effects can be reduced in several ways.

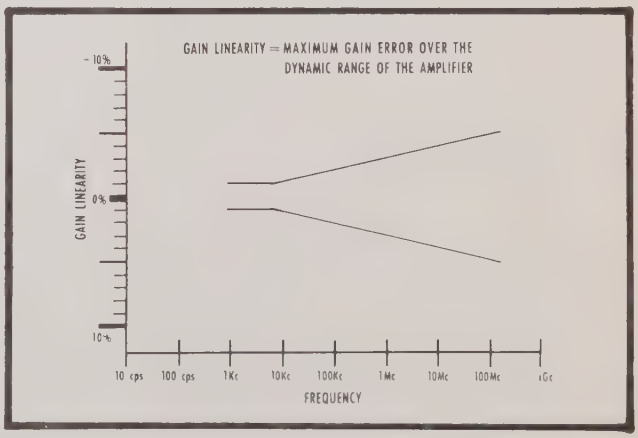


FIGURE 4. Models 110 and 111 Gain Linearity. The gain linearity falls within the limits shown above from 1 kc to 150 Mc

a. Make all ground lead impedances as low as possible.

b. Employ only coaxial hookups wherever possible.

2-10. STRAY FIELDS. Stray fields can induce unwanted emf's in the test system. The inaccuracies due to these fields become more significant as measurements become more sensitive. Induced emf's may be reduced by using coaxial cable having minimum loop area and by using cables of minimum length.

f	500 cps	1 kc	10 kc	100 kc	1 Mc	10 Mc	100 Mc	150 Mc
Z	9.4 MΩ	8 MΩ	1.3 kΩ	130 kΩ	13 kΩ	1.3 kΩ	133 Ω	74 Ω

TABLE 1. Approximate Input Impedance (Z) at Various Frequencies (f) for Models 110 and 111. Impedances are based on a 10-megohm input resistor shunted by 12 picofarads.

SECTION 3. CIRCUIT DESCRIPTION

3-1. GENERAL.

a. The Models 110 and 111 are three-stage solid-state amplifiers. They use a source-follower field-effect transistor input stage followed by two transistor amplifier stages.

b. Both Amplifiers are of conventional RC-coupled cascade design, using negative feedback. There is no inductive peaking. The wide bandwidth is achieved using selected epitaxial mesa transistors with 1-gigacycle f_t.

c. Careful circuit design allows maximum performance. Point-to-point wiring minimizes lead inductance. Silver plating on the chassis minimizes ground loops and reduces resistance due to skin effect at high frequencies. Using solid-state components, hermetically sealed tantalum capacitors and metal film resistors insures excellent stability and long, trouble-free operation.

NOTE

Refer to Schematic Diagram 18739D for circuit designations.

3-2. AMPLIFIER DESIGN.

a. The input signal is applied to the field-effect transistor, Q101. The signal is then amplified by two stages, transistors Q102 and Q103, to make up the signal loss in Q101.

b. The feedback loop is through resistor R115 and capacitor C112. The output of transistor Q103 is divided by resistor R115 and a network of resistors consisting of resistors R107, R113, and R114. Potentiometer R114 adjusts the gain at the lower frequencies. Trimmers C107, C108 and C115 adjust the gain of the amplifier at the higher frequencies. Internal adjustments are necessary because of transistor parameter variations, and these are set for the particular components used in the circuit.

SECTION 4. SERVICING

4-1. GENERAL. Section 4 contains the maintenance and troubleshooting procedures for the Models 110 and 111. Follow these as closely as possible to maintain the instrument's specifications.

4-2. SERVICING SCHEDULE. The Models 110 and 111 require no periodic maintenance beyond the normal care required of high-quality electronic equipment. Occasional checks of the frequency or pulse response of the Amplifier should show the need for any adjustment. No part should need frequent replacement under ordinary use.

4-3. PARTS REPLACEMENT.

a. The Replaceable Parts List in Section 7 describes the electrical components of the Amplifiers. Replace components only as necessary. Use only reliable replacements which meet the specifications. Check the frequency or pulse response after any transistor is replaced.

b. The transistors are selected for parameters which allow wide frequency response. Order these parts only from Keithley Instruments, Inc., or its representatives.

NOTE

Physical location of components greatly affects high frequency response. Put replaced parts and their leads in their exact previous position.

4-4. TROUBLESHOOTING.

a. The procedures which follow give instructions for repairing troubles which might occur in the Models 110 and 111. Use the procedures outlined and use only specified replacement parts. Make sure the external circuits are checked. Table 2 lists equipment recommended for troubleshooting. If the trouble cannot be located or repaired, contact the nearest Keithley representative.

Instrument	Use
True RMS Voltmeter, 500 cps to 150 Mc, ±5% accuracy	Measure ac voltages
Keithley Instruments Model 153 DC Microvolt-Ammeter, 3% accuracy, 20 megohm input resistance	Measure dc voltages
Simpson Models 260 and 650 Transistor Beta Testers	Check transistors
Tektronix Type 504 Oscilloscope, passband dc to 450 kc	Observe wave forms

TABLE 2. Equipment Recommended for Troubleshooting. Use these instruments or their equivalents.

Trouble	Probable Cause	Remedy
Amplifier will not operate	Faulty transistor	Check Q101, Q102, Q103; replace if faulty
Noise with Amplifier exceeds 75 microvolts	Faulty transistor	Check Q101, Q102, Q103; replace if faulty
	Excessive ripple from power supply	Check power supply. Check filters C103, C106, C109, C110, C114 and C117.
Gain is more or less than one	Potentiometer R114 out of adjustment	Adjust R114 per paragraph 5-3
Model 110 frequency response not flat within specifications	Amplifier out of calibration	Calibrate per paragraph 5-4
Model 111 exceeds overshoot specification	Amplifier out of calibration	Calibrate per paragraph 5-5
Rise time of Amplifier not within specification	Amplifier out of calibration	Adjust Model 110 per paragraph 5-4, Model 111 per paragraph 5-5

TABLE 3. Models 110 and 111 Troubleshooting. Refer to paragraph 4-4 before troubleshooting the Amplifier.

b. Before troubleshooting the Amplifier, check the external circuits, especially the power supply. Make sure the Amplifier output is terminated into a good 50-ohm load. Check the coaxial cables and connections. Check the performance of the signal generator and other instruments. (The Amplifier will faithfully amplify any signal fed to it; a poor input results in a poor output.) Make sure the output signal does not exceed 700 millivolts peak-to-peak. If the external circuits are good, check the Amplifier itself.

c. Table 3 contains troubles which might occur with the instrument. If the repairs indicated in the table do not clear up the trouble, continue to search through a circuit-by-circuit check. Refer to the circuit description in Section 3 to find the more crucial components and to determine their function in the circuit. The complete circuit schematic diagram, 18739D, is in Section 7.

d. If the instrument will not operate, check the power source. If it is satisfactory, continue to isolate the trouble.

SECTION 5. CALIBRATION

5-1. GENERAL.

a. The following procedures are recommended for calibrating and adjusting the Models 110 and 111. Use the equipment recommended in Table 4. If proper facilities are not available or if difficulty is encountered, contact Keithley Instruments, Inc., or its representative to arrange for factory calibration.

b. Three calibrations are in the procedures: low-frequency calibration, high-frequency wideband calibration and pulse calibration. In addition, paragraph 5-6 outlines test procedures to check response and paragraphs 5-7 and 5-8 contain tuning instructions when the Amplifier drives a cable.

c. If the instrument is not within specifications after the calibration, follow the troubleshooting procedures or contact Keithley Instruments, Inc., or its representative.

Instrument	Use
General Radio GR-874 type attenuators, 3 db, 6 db, 10 db and 20 db	High frequency calibration
General Radio GR-874-WM50 50-ohm termination (also found in Keithley Instruments Model 1042 Accessory Kit)	Amplifier termination
Hewlett-Packard Model 202A Audio Oscillator, 20 cps to 40 kc, ±2%	Signal generator for low-frequency calibration
Jarrold Electronics Model 900-B Sweep Signal Generator (includes Model D50 Detector), 500 kc to 1200 Mc	Signal generator for Model 110 band response
True RMS Voltmeter, 500 cps to 150 Mc, ±5% accuracy	Measure ac voltages
Tee and adapters (found in Keithley Instruments Model 1042 Accessory Kit)	Hook up calibration circuits
Tektronix Type 111 Pulse Generator, 0.5-nsec rise time, 2 to 20-nsec pulse duration	Check Model 111 pulse response
Tektronix Type 504 Oscilloscope, passband from dc to 450 kc	Check wave form during tuning and view sweep display of Model 110
Tektronix Type 561A Oscilloscope, with dual trace plug-in sampling units, 0.4-nsec rise time	View Model 111 pulse response

TABLE 4. Equipment Recommended for Models 110 and 111 Calibration. Use these instruments or their equivalents.

5-2. CALIBRATION SCHEDULE. Check the Amplifier response yearly or when transistors are changed. Refer to paragraph 5-4 (Model 110) or 5-5 (Model 111) for procedures; recalibrate completely if the response is not correct. Always recalibrate the high-frequency gain if the low-frequency gain is adjusted.

Control	Circuit Desig.	Fig. Ref.	Refer to Paragraph
High Frequency	C107	14	5-4 (110) 5-5 (111)
	C108	14	
	C115	14	
Low Frequency	R114	14	5-3

TABLE 5. Models 110, 111 Internal Controls. The Table lists all internal controls, the figure picturing the location, and the paragraph describing the adjustment.

5-3. MODELS 110, 111 LOW-FREQUENCY CALIBRATION.

a. Remove the Amplifier cover by removing the four screws. Connect the Amplifier to the Model 1081 Power Supply.

b. Connect the Model 202A Oscillator to Amplifier INPUT. Adjust the oscillator signal to 250 millivolts rms at 5 kc. Connect the True RMS Voltmeter, the Type 504 Oscilloscope and the 50-ohm termination to the Amplifier OUTPUT. The output signal should be 250 millivolts rms ±6 millivolts. Adjust potentiometer R114 (Figure 14), if necessary, for this output.

c. Monitor the output signal on the oscilloscope and check for distortion from the sine wave.

NOTE

The low-frequency calibration establishes the base for the high-frequency response. Therefore, tune the Amplifier at the high frequencies after tuning it at the low frequencies.

5-4. MODEL 110 HIGH-FREQUENCY CALIBRATION.

a. Remove the Amplifier cover by removing the four screws. Connect the Amplifier to the Model 1081 Power Supply. Connect the Model 900-B Sweep Generator to the Amplifier INPUT; terminate the input signal with 50 ohms. See Figure 5. Connect the Amplifier OUTPUT to the Model D50 Detector.

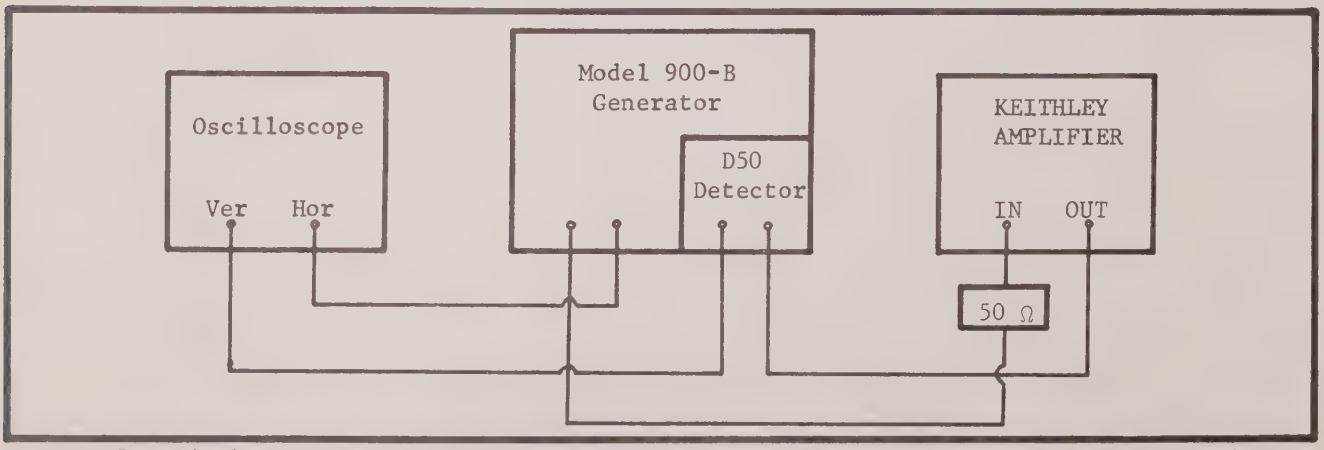


FIGURE 5. Block Diagram for Model 110 High-Frequency Calibration. Refer to Table 4 for equipment. Terminate Model 110 input into 50 ohms.

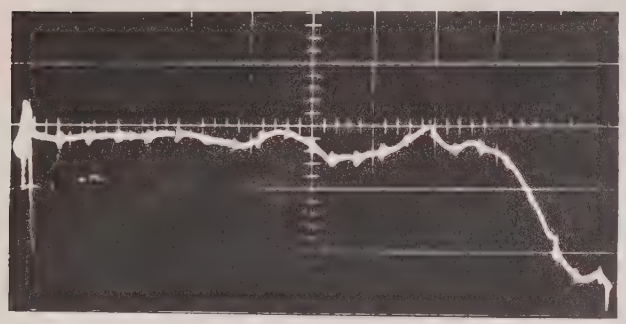


FIGURE 6. Model 110 Response Curve. Display signal of 200 millivolts rms is from a sweep generator. Each pip represents 10 Mc, zero is at the extreme left.

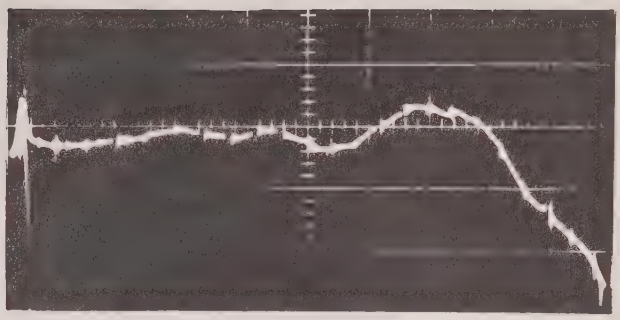


FIGURE 7. Model 110 Response Curve with 3 db Pad. The circuit is the same as that for Figure 6, except a 3 db pad attenuates the 200-millivolt input signal.

b. Adjust the generator signal to 200 millivolts rms and center the frequency at 100 megacycles. Adjust the oscilloscope for a vertical display of 5%/cm.

c. The low frequency gain should be previously set (paragraph 5-3). Use trimmer C115 (Figure 14) to adjust the low-range gain - around 50 megacycles - trimmer C107 (Figure 14) to adjust the mid-range gain - 50 to 100 megacycles - and trimmer C108 (Figure 14) to adjust the high-range gain. Adjust the response as flat as possible. Refer to Figure 6 for a typical response curve.

d. Insert a 3 db pad and re-adjust the oscilloscope for a vertical display of 5%/cm. Check for a response of 5%. See Figure 7 for a typical response curve.

e. Using the oscilloscope vertical position control, put the display trace on a reference line. Remove the 3 db pad. The 15-Mc point should now be above the previously set reference line.

5-5. MODEL 111 HIGH-FREQUENCY CALIBRATION.

a. Remove the Amplifier cover by removing the four screws. Connect the Amplifier to the Model 1081 Power Supply.

b. Connect the Type 111 Pulse Generator to the Sampling Oscilloscope. Use attenuators (approximately 26 db) to adjust for a 0.7-volt peak pulse on the oscilloscope. Use the delay cable on the pulse generator to adjust the pulse width to approximately 20 nanoseconds. Set the oscilloscope horizontal sweep to 5 nanoseconds/cm and the vertical sensitivity to 200 millivolts/cm. If necessary, use the pretrigger output of the pulse generator to synchronize the oscilloscope. Note the amount of overshoot and the shape on the pulse's leading edge.

NOTE

The Amplifier is being calibrated at maximum output. Do not put in larger pulses than specified. This will cause overshooting and result in an improperly calibrated amplifier.

c. Add a tee (included in the Model 1042 Kit) and connect the pulse generator to the Amplifier INPUT; terminate the input signal with 50 ohms. Attenuate the signal approxi-

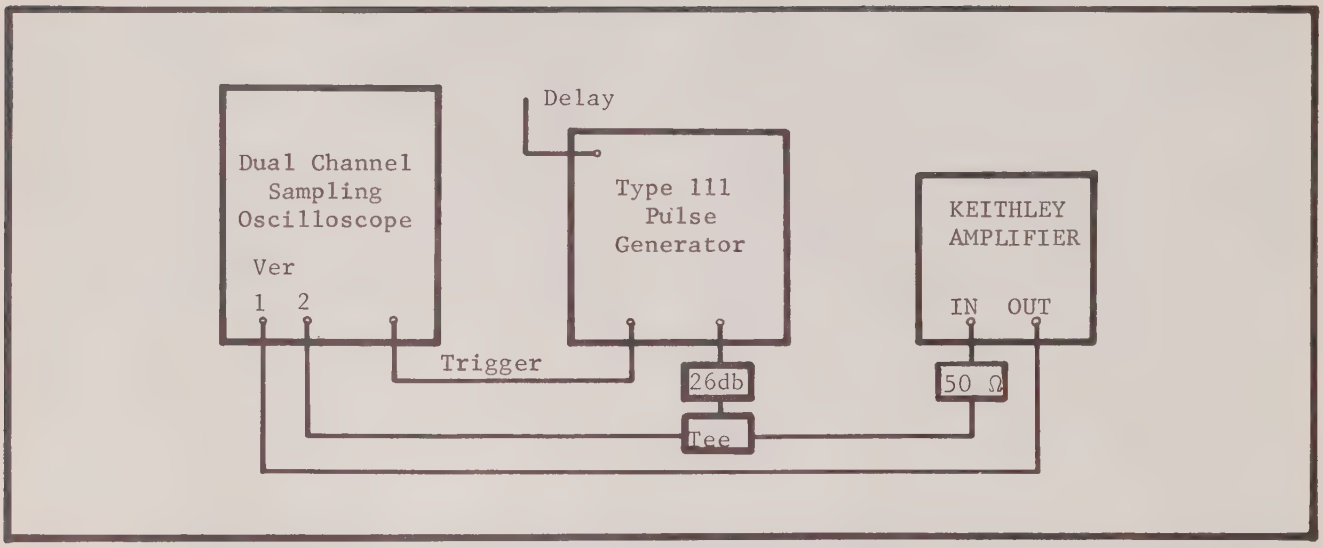


FIGURE 8. Block Diagram for Model 111 High-Frequency Calibration. Terminate Model 111 input into 50 ohms. Refer to Table 4 for equipment.

mately 6 db more. See Figure 8. Connect the Amplifier OUTPUT to the oscilloscope's other vertical input. Note the oscilloscope has 50 ohms impedance, which terminates the amplifier output.

d. The low-frequency gain should be previously set (paragraph 5-3). Set trimmers C107, C108 and C115 (Figure 14) to their minimum values. Set trimmer C115 to approximately 1/3 of its maximum value. Adjust trimmers C107 and C108 alternately until the output pulse looks exactly like the input pulse (Figure 11). If the input pulse has less than 3% overshoot and ringing, adjust trimmers C107 and C108 for less than 3% overshoot and ringing on the output pulse.

5-6. LOW-FREQUENCY RESPONSE CHECK. Connect the Model 202A Oscillator to the Amplifier INPUT. Adjust the oscillator signal for 250 millivolts rms at 5 kc. Use the True RMS Voltmeter to monitor the amplifier output. Terminate the output into 50 ohms. Gradually decrease the signal frequency. The output amplitude should not vary more than 5% until 1 kc.

5-7. TUNING MODEL 110 TO DRIVE CABLES.

a. The Model 110 may be tuned to make up for cable loss — up to 2.5 db loss at 200 Mc — where this is a critical problem. It will drive up to 100 feet of cable without loss or degradation of the response characteristics.

b. Tuning the Model 110 to drive a cable is esentially attaching the cable of the desired length to the Amplifier OUTPUT and performing the high frequency calibration of paragraph 5-4. The recommended cable is Amphenol or Belden polyethylene cable (RG8/U) rated at 50 ohms and having 29.5 picofarads/foot. Recommended maximum distance is 100 feet. If other cables and greater lengths are used, Amplifier performance will be below specifications.

c. Tuning Procedures. Connect the cable to the Amplifier OUTPUT. Then follow the procedures for the Model 110 high-frequency calibration, paragraph 5-4. Consider the end of

the cables as the Amplifier OUTPUT. It is not necessary to tune the Amplifier at low frequencies.

5-8. TUNING MODEL 111 TO DRIVE CABLES.

a. The Model 111 may be tuned to make up for cable loss — up to 2.5 db loss at 200 Mc — where this is a critical problem. It will drive up to 100 feet of cable without loss or degradation of the response characteristics.

b. Tuning the Model 111 to drive a cable is essentially attaching the cable of the desired length to the Amplifier output and performing the high frequency calibration of paragraph 5-5. The recommended cable is Amphenol or Belden polyethylene cable (RG8/U) rated at 50 ohms and having 29.5 picofarads/foot. Recommended maximum distance is 100 feet. If other cables and greater lengths are used, Amplifier performance will be below specifications.

c. Tuning Procedures. Connect the cable to the Amplifier OUTPUT. Then follow the procedures for the Model 111 high-frequency calibration, paragraph 5-5. Consider the end of the cable as the Amplifier OUTPUT. It is not necessary to tune the Amplifier at low frequencies.

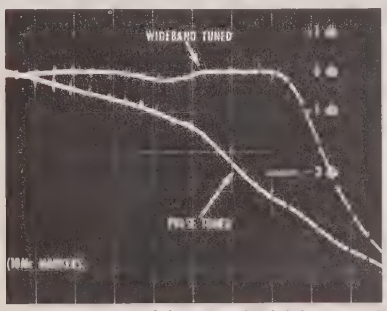


FIGURE 9. Models 110 and 111 Bandwidth Characteristics. The Model 110 is wideband tuned; the Model 111, pulse tuned. The response is from 0 cps (extreme left) to 240 Mc; each pip represents 10 Mc. Display signal of 50 mv rms is from a sweep generator. The excellent flatness of the wideband amplifier is gained at the expense of overshoot and ringing on pulses.

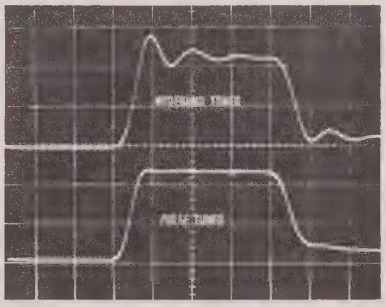


FIGURE 10. Models 110 and 111 Overshoot Characteristics. The Model 110 is wideband tuned; the Model 111, pulse tuned. The oscilloscope is set for 5 nsec/cm horizontal, 0.2 v/cm vertical. The pulse amplifier has minimum pulse distortion at the expense of flatness (see Figure 9).

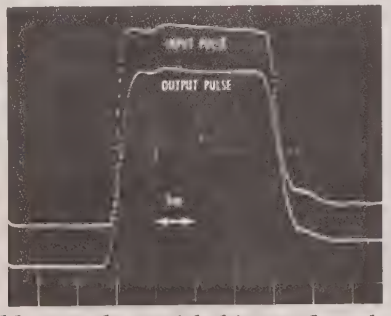


FIGURE 11. Pulse Fidelity of Model 111 Pulse Amplifier. Note how the output pulse follows the input pulse.

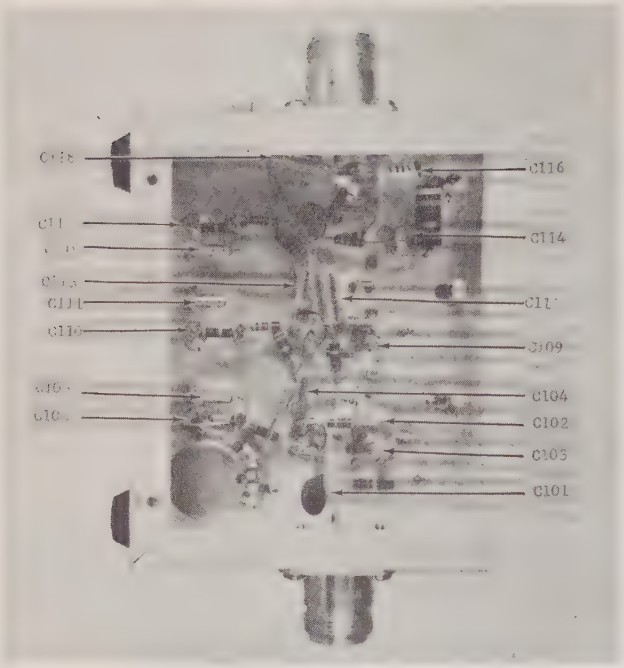


FIGURE 12. Capacitor Locations. The INPUT Receptacle is at the bottom of the illustration. Both the Models 110 and 111 have the same component locations.

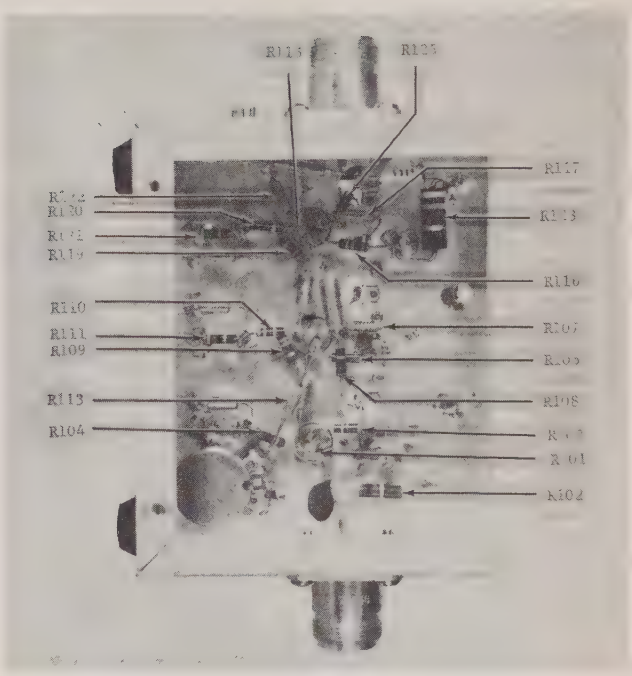


FIGURE 13. Resistor Locations. The INPUT Receptacle is at the bottom of the illustration. Both the Models 110 and 111 have the same component locations.

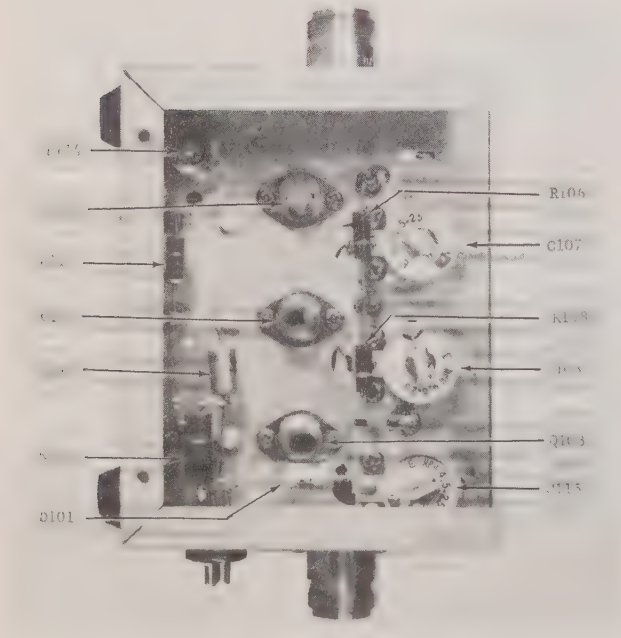


FIGURE 14 (left). Component Locations, Reverse Side. The INPUT Receptacle is at the top of the illustration. Both the Models 110 and 111 have the same component locations.

SECTION 6. ACCESSORIES

6-1. GENERAL. Several accessories increase the usefulness of the Amplifiers. This Section describes the Model 1081 Power Supply, the Models 1041 and 1042 Accessory Kits and the Model 1082 Mounting Plate.

6-2. MODEL 1081 POWER SUPPLY.

a. General. The Keithley Model 1081 Power Supply furnishes the power required for one to three Models 108, 109, 110 and 111 Amplifiers. No adjustment is necessary. Refer to Section 7 for the Power Supply Replaceable Parts List and Schematic Diagram.

b. Specifications.

Output: As required for 1, 2 or 3 Models 108, 109, 110 and 111 Amplifiers. 28 volts dc floating; ±5% accuracy; ±0.1% stability; 40 milliamperes current (1 watt); 2-millivolt peak-to-peak maximum ripple.

Power Required: 105-125 or 210-250 volts, 50-400 cps, 12 watts.

Dimensions, Weight: 3 inches high x 2-1/4 inches wide x 3-3/4 inches deep; net weight, 1-1/2 pounds.

Accessories Supplied: Three Model 1083 Power Cables 3 feet long for connecting the Model 1081 to the Amplifiers.

FIGURE 15. Keithley Instruments Model 1081 Power Supply.

c. Operation. Use the Model 1083 Power Cable to connect the Power Supply to the Amplifier. One, two or three Amplifiers can be connected at one time. Connect the Model 1081 to the power line. Snap the front panel slide switch on to turn the instrument on. No warm-up time or adjustment is necessary. For 234-volt power sources, refer to Schematic Diagram 17966C for rewiring the transformer.

d. Circuit. (Refer to Schematic Diagram 17966C.) The Model 1081 is relatively simple for its specifications. Unregulated voltage from the transformer, T1, is rectified by diodes D101 to D104 and filtered by capacitor C101. The voltage is applied to transistor Q1, connected as a series regulator. The output is sampled by resistors R106 and R108 and compared to the voltage across zener reference diode D106. Any voltage difference is amplified by transistors Q2 and Q3, operating as a differential voltage amplifier, and applied to the series regulator. The fuse is in series with the output. If the Power Supply is overloaded, the fuse will blow. Ordinarily, the fuse will not blow, even if Amplifiers are connected or disconnected while the Power Supply is on.

Item Fig. 16	Description	Keithley Part No.
1	Adapter, male n to female bnc	CS-116
2	Adapter, male n to female uhf	CS-114
3	High Pass Filter	CS-121
4	Adapter, male n to General Radio Type 874	CS-109
5	75-ohm Termination, male n to female n	CS-118
6	Adapter, General Radio Type 874 to banana plug	CS-111
7	Patch Cable (not part of Kit)	18249B
8	Patch Cable (not part of Kit)	18249B
9	Probe Adapter, male n to female uhf	Model 1041-1
10	Adapter, female n to General Radio Type 874	CS-110
11	93-ohm Termination, male n to female n	CS-119

TABLE 6. Contents of Model 1041 Accessory Kit.

6-3. MODEL 1041 ACCESSORY KIT.

a. The Model 1041 Accessory Kit provides useful adapters, terminations and a high-pass filter for use with the Amplifiers. The kit case is 2 inches high x 12 inches wide x 8 inches deep with polyethylene-foam-compartments. It weighs approximately three pounds.

b. The 75 and the 93-ohm terminations can be used to connect 75 and 93-ohm systems directly into the Amplifier.

c. The high-pass filter, which reduces the low-frequency noise, has a -3 db point at 10 kc. Use it at the Amplifier OUTPUT to reduce low-frequency noise.

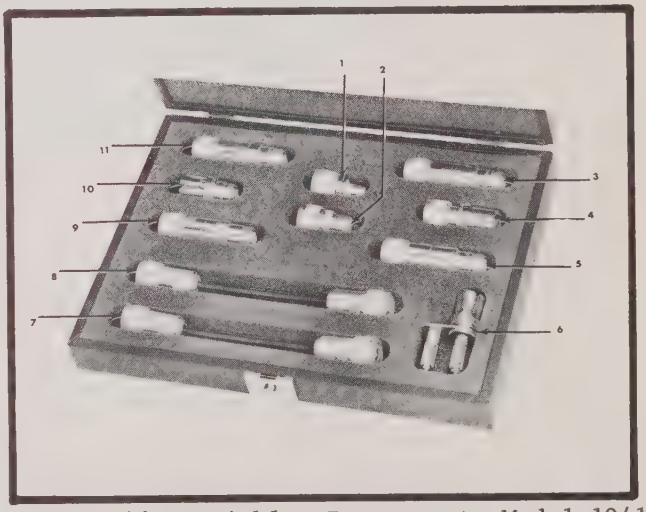


FIGURE 16. Keithley Instruments Model 1041 Accessory Kit. See Table 6 for contents.

d. The Kit will hold the two patch cables furnished with the Models 104 and 105. The cables are not part of the Kit. The Model 1041-1 Probe Adapter is also used with the Models 104 and 105.

6-4. MODEL 1042 ACCESSORY KIT. The Model 1042 Accessory Kit provides useful adapters, a 50-ohm termination and a tee for use with the Amplifiers. The size and weight of the kit case is the same as that of the Model 1041 Accessory Kit.

6-5. MODEL 1082 MOUNTING PLATE. (Refer to Figure 18 for dimensions.)

a. The Model 1082 enables an Amplifier or Model 1081 to be installed in a system. It provides a mounting surface for O. E. M. applications.

Item Fig. 17	Description	Keithley Part No.
1	50-ohm Termination, General Radio Type 874	CS-159
2	Adapter, male n to female uhf	CS-114
3	Adapter, male n to female bnc	CS-116
4	Adapter, male n to male n	CS-158
5	Adapter, male n to General Radio Type 874	CS-109
6	Adapter, n-type tee	CS-157
7	Adapter, male n to General Radio Type 874	CS-109
8	Adapter, male n to male n	CS-158
9	Adapter, male n to female bnc	CS-116
10	Adapter, male n to female uhf	CS-114

TABLE 7. Contents of Model 1042 Accessory Kit.

b. To mount an instrument on the Plate, remove the four feet from the Amplifier or Power Supply. Attach the Plate to the instrument with the No. 4 flathead screws. Make sure the screw heads are flush with the Plate to avoid interference. The Plate and instrument may be mounted to another surface in any desired position.

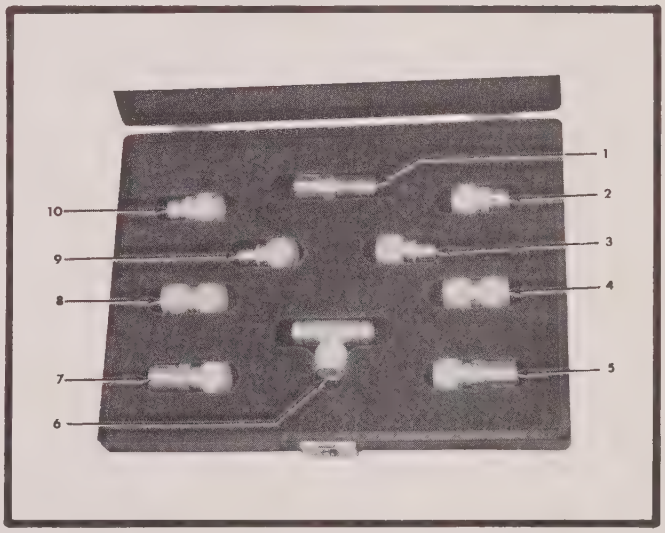


FIGURE 17. Keithley Instruments Model 1042 Accessory Kit. See Table 7 for contents.

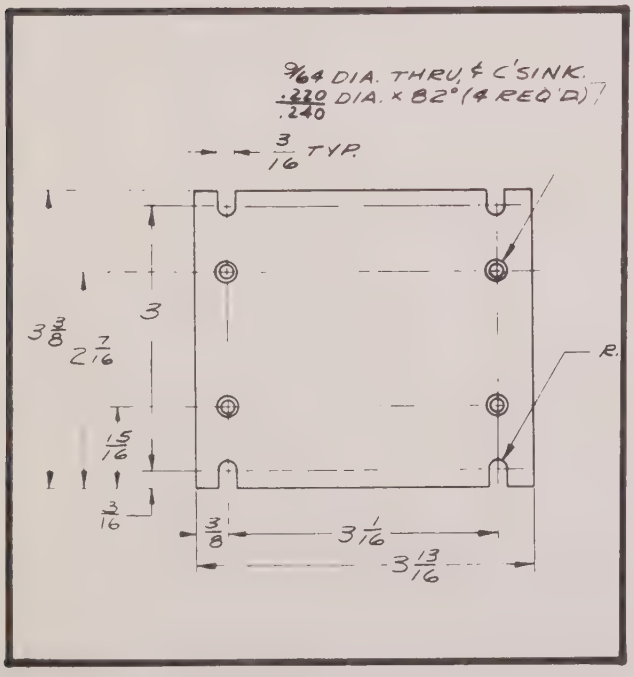


FIGURE 18 (left). Dimensions of the Model 1082 Mounting Plate.

SECTION 7. REPLACEABLE PARTS

7-1. REPLACEABLE PARTS LIST. The Replaceable Parts List describes the components of the Models 110 and 111 and their accessories. Unless otherwise indicated, all listed parts are for both Models. The List gives the circuit designation, the part description, a suggested manufacturer, the manufacturer's part number and the Keithley Part Number. The last column indicates the figure picturing the part. The name and address of the manufacturers listed in the "Mfg. Code" column are in Table 9.

7-2. HOW TO ORDER PARTS.

a. For parts orders, include the instrument's model and serial number, the Keithley Part Number, the circuit designation and a description of the part. All structual parts and those parts coded for Keithley manufacture (80164) must be ordered through Keithley Instruments, Inc., or its representatives. In ordering a part not listed in the Replaceable Parts List, completely describe the part, its function and its location.

b. Order parts through your nearest Keithley representative or the Sales Service Department, Keithley Instruments, Inc.

Cb	Carbon	M	Mega (10^6)
CerD	Ceramic, disc	Mfg.	Manufacturer
CerT	Ceramic, tubular	Mil. No.	Military Type Number
CerTr	Ceramic, trimmer	MtF	Metal Film
Comp	Composition		
		Ω	ohm
ETT	Electrolytic Tantalum		
		p	pico (10^{-12})
f	farad		
		Ref.	Reference
Fig.	Figure		
FT	Feed Through	μ	micro (10^{-6})
k	kilo (10^3)	v	volt
		w	watt

TABLE 8. Abbreviations and Symbols.

MODELS 110 and 111 REPLACEABLE PARTS LIST

(Refer to Schematic Diagram 18739D for circuit designations)

CAPACITORS

Circuit Desig.	Value	Rating	Type	Mfg. Code	Mfg. Part No.	Keithley Part No.	Fig. Ref.
C101	.0001 µf	600 v	CerD	72982	ED-.0001	C22-.0001M	12
C102	1.2 µf	20 v	ETT	05397	Type J	C80-1.2M	12
C103	500 pf	1000 v	ET	71590	MFT500	C15-500P	12
C104	1.2 µf	20 v	ETT	05397	Type J	C80-1.2M	12
C105	1.2 µf	20 v	ETT	05397	Type J	C80-1.2M	12
C106	500 pf	1000 v	FT	71590	MFT500	C15-500P	12
C107	4.5-25 pf	500 v	CerTr	71590	822AZ	C76-4.5/25P	14
C108	4.5-25 pf	500 v	CerTr	71590	822AZ	C76-4.5/25P	14
C109	500 pf	1000 v	FT	71590	MFT500	C15-500P	12
C110	500 pf	1000 v	FT	71590	MFT500	C15-500P	12
C111	1.2 µf	20 v	ETT	05397	Type J	C80-1.2M	12
C112	4.7 µf	20 v	ETT	05397	Type J	C80-4.7M	12
C113	.27 µf	20 v	ETT	05397	Type J	C80-.27M	12
C114	500 pf	1000 v	FT	71590	MFT500	C15-500P	12
C115	4.5-25 pf	500 v	CerTr	71590	822AZ	C76-4.5/25P	14
C116	10 pf	600 v	CerT	71590	TCZ-10	C72-10P	12
C117	500 pf	1000 v	FT	71590	MFT500	C15-500P	12
C118	4.7 µf	20 v	ETT	05397	Type J	C80-4.7M	12
C119	1.2 µf	20 v	ETT	05397	Type J	C80-1.2M	12

DIODES

Circuit Desig.	Type	Number	Mfg. Code	Keithley Part No.	Fig. Ref.
D101	Silicon	1N3253	02735	RF-20	14
D102	Silicon	1N3253	02735	RF-20	14

MISCELLANEOUS PARTS

Circuit Desig.	Description	Mfg. Code	Keithley Part No.	Fig. Ref.
J101	Receptacle, n, INPUT, Mil. No. UG-58/U	02660	CS-168	
J102	Receptacle, n, OUTPUT, Mil. No. UG-58/U	02660	CS-168	
—	(F) Plug, n, Mate of J101 and J102, Mil No. UG-536/U (Mfg. No. 309-34000)	02660	CS-96	

(F) Furnished accessory

MISCELLANEOUS PARTS (Cont'd)

Circuit Desig.	Description	Mfg. Code	Keithley Part No.	Fig. Ref.
J103	Receptacle, POWER			
	.Locking Ring (Mfg. No. 126-1428)	02660	CS-160	
	.Receptacle (Mfg. No. 126-1427)	02660	CS-162	
	.Nut (Mfg. No. 41-153)	02660	CS-164	
---	Plug, Mate of J103 (Mfg. No. 126-1429)	02660	CS-163	

RESISTORS

Circuit Desig.	Value	Rating	Type	Mfg. Code	Mfg. Part No.	Keithley Part No.	Fig. Ref.
R101	*100 Ω	10%, 1/4 w	Comp	01121	CB	R76-100	13
R102	10 MΩ	10%, 1/2 w	Comp	01121	EB	R1-10M	13
R103	470 Ω	10%, 1/4 w	Comp	01121	CB	R76-470	13
R104	6.8 kΩ	10%, 1/4 w	Comp	01121	CB	R76-6.8K	13
R105	15 kΩ	10%, 1/4 w	Comp	01121	CB	R76-15K	13
R106	10 Ω	10%, 1/2 w	Comp	01121	EB	R1-10	14
R107	60.4 Ω	1%, 1/8 w	MtF	07716	CEA-TO	R88-60.4	13
R108	68 Ω	10%, 1/4 w	Comp	01121	CB	R76-68	13
R109	4.7 kΩ	10%, 1/4 w	Comp	01121	CB	R76-4.7K	13
R110	330 Ω	10%, 1/4 w	Comp	01121	CB	R76-330	13
R111	47 Ω	10%, 1/4 w	Comp	01121	CB	R76-47	13
R112	470 Ω	10%, 1/4 w	Comp	01121	CB	R76-470	14
R113	49.9 Ω	1%, 1/8 w	MtF	07716	CEA-TO	R88-49.9	13
R114	1 kΩ	20%, 0.2 w	CbVar	71450	Series 70	RP31-1K	14
R115	249 Ω	1%, 1/8 w	MtF	07716	CEA-TO	R88-249	13
R116	15 kΩ	10%, 1/4 w	Comp	01121	CB	R76-15K	13
R117	75 Ω	1%, 1/8 w	MtF	07716	CEA-TO	R88-75	13
R118	10 Ω	10%, 1/2 w	Comp	01121	EB	R1-10	14
R119	3.3 kΩ	10%, 1/4 w	Comp	01121	CB	R76-3.3K	13
R120	220 Ω	10%, 1/4 w	Comp	01121	CB	R76-220	13
R121	47 Ω	10%, 1/4 w	Comp	01121	CB	R76-47	13
R122	33.2 Ω	1%, 1/8 w	MtF	07716	CEA-TO	R88-33.2	13
R123	470 Ω	10%, 1 w	Comp	01121	GB	R2-470	13
R124	1 kΩ	10%, 1 w	Comp	01121	GB	R2-1K	14
R125	100 Ω	10%, 1/4 w	Comp	01121	CB	R76-100	13

TRANSISTORS

Circuit Desig.	Number	Mfg. Code	Keithley Part No.	Fig. Ref.
Q101	U-1384	16170	TG-34	14
Q102	SM492	80164	TG-17-6	14
Q103	SM492	80164	TG-17-6	14

MODEL 1081 REPLACEABLE PARTS LIST

(Refer to Schematic Diagram 17966C for circuit designations.)

CAPACITORS

Circuit Desig.	Value	Rating	Type	Mfg. Code	Mfg. Part No.	Keithley Part No.	Fig. Ref.
C101	75 μf	100 v	ETB	56289	TE14	C60-75M	
C102	75 μf	100 v	ETB	56289	TE14	C60-75M	
C103	0.1 μf	50 v	My	84411	601PE	C41-0.1M	
C104	2.2 μf	20 v	ETT	05397	K2R2J20K	C80-2.2M	
C105	10 μf	35 v	ETT	05397	K10J35KS	C81-10M	
C106	100 μf	25 v	ETT	05079	W100-25C2U1	C96-100M	
C107	100 μf	25 v	ETT	05079	W100-25C2U1	C96-100M	

DIODES

Circuit Desig.	Type	Number	Mfg. Code	Keithley Part No.	Fig. Ref.
D101	Silicon	1N3253	02735	RF-20	
D102	Silicon	1N3253	02735	RF-20	
D103	Silicon	1N3253	02735	RF-20	
D104	Silicon	1N3253	02735	RF-20	
D105	Zener	1N709	12954	DZ-21	
D106	Zener	1N935	04713	DZ-7	

MISCELLANEOUS PARTS

Circuit Desig.	Description	Mfg. Code	Keithley Part No.	Fig. Ref.
DS1	Neon Pilot Lamp (Mfg. No. 2190)	91802	PL-28	
F1 (117 v) F1 (234 v)	Fuse, quick acting, .2 amp, 8 AG (Mfg. No. 361.200)	75915	FU-24	
—	Fuse Holder (Mfg. No. 372001)	75915	FH-8	

MISCELLANEOUS PARTS (Cont'd)

Circuit Desig.	Description	Mfg. Code	Keithley Part No.	Fig. Ref.
J101 to J103	Socket			
	.Locking Ring (Mfg. No. 126-1428)	02660	CS-160	
	.Plug (Mfg. No. 126-1429)	02660	CS-163	
	.Nut (Mfg. No. 41-153)	02660	CS-164	
—	Receptacle, Mate of J101 (Mfg. No. 126-1427)	02660	CS-162	
P1	Cord Set, 6 feet (Mfg. No. 4638-13)	93656	CO-5	
S1	Slide Switch, Power (Mfg. No. G326)	79727	SW-45	
T1	Transformer	80164	TR-84	

RESISTORS

Circuit Desig.	Value	Rating	Type	Mfg. Code	Mfg. Part No.	Keithley Part No.	Fig. Ref.
R101	47 kΩ	10%, 1/2 w	Comp	01121	EB	R1-47K	
R102	1.5 kΩ	10%, 1/2 w	Comp	01121	EB	R1-1.5K	
R103	15 Ω	.1%, 1/4 w	WW	01686	7009	R96-15	
R104	3.3 kΩ	10%, 1/2 w	Comp	01121	EB	R1-3.3K	
R105	2.2 kΩ	10%, 1/2 w	Comp	01121	EB	R1-2.2K	
R106	2.2 kΩ	1%, 1/2 w	DCb	79727	CFE-15	R12-2.2K	
R107	33 kΩ	10%, 1/2 w	Comp	01121	EB	R1-33K	
R108	1 kΩ	1%, 1/2 w	DCb	79727	CFE-15	R12-1K	
R109	47 kΩ	10%, 1/2 w	Comp	01121	EB	R76-47K	

TRANSISTORS

Circuit Desig.	Number	Mfg. Code	Keithley Part No.	Fig. Ref.
Q1	2N1183A	02735	TG-31	
Q2	2N1377	01295	TG-30	
Q3	2N1381	01295	TG-8	

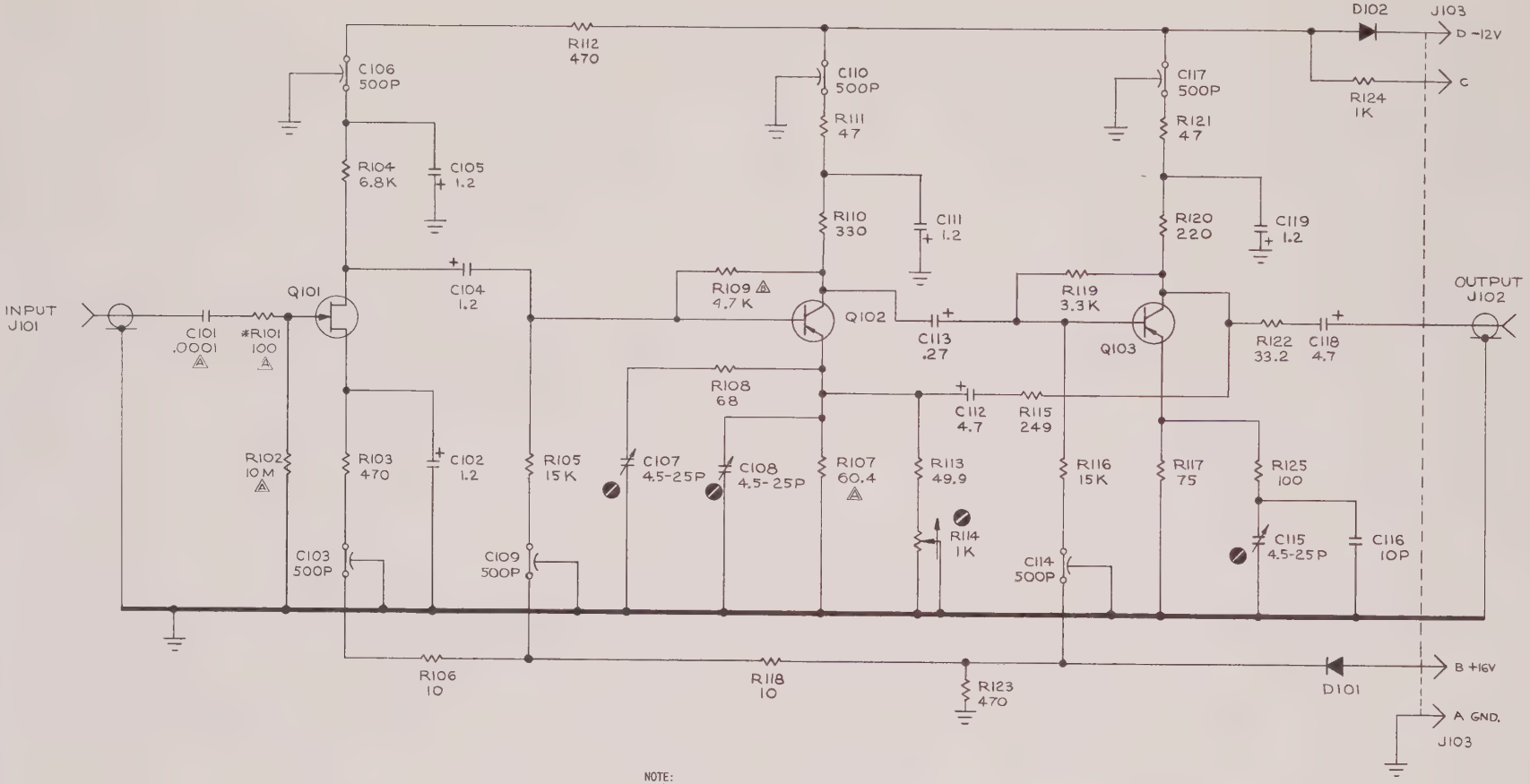
(F) MODEL 1083 REPLACEABLE PARTS LIST

Description	Mfg. Code	Keithley Part No.
Receptacle (Mfg. No. 126-1427)	02660	CS-162
Plug (Mfg. No. 126-1429)	02660	CS-163

(F) Furnished accessory.

01121	Allen-Bradley Corp. Milwaukee, Wis.	16170	Amelco Inc. Los Angeles, Calif.
01295	Texas Instruments, Inc. Semiconductor-Components Dallas, Texas	56289	Sprague Electric Co. North Adams, Mass.
02660	Amphenol-Borg Electronics Corp. Broadview, Chicago, Illinois	71590	Centralab Division of Globe-Union, Inc. Milwaukee, Wis.
02735	Radio Corp. of America Commercial Receiving Tube and Semiconductor Division Somerville, N. J.	72982	Gudeman Co. Chicago, Ill.
04713	Motorola, Inc. Semiconductor Products Division Phoenix, Arizona	73690	Elco Resistor Company New York, N. Y.
05079	Tansitor Electronics, Inc. Bennington, Vt.	75915	Littelfuse, Inc. Des Plaines, Ill.
05397	Union Carbide Corp. Linde Division Kemet Dept. Cleveland, Ohio	79727	Continental-Wirt Electronics Corp. Philadelphia, Pa.
07716	International Resistance Co. Burlington, Iowa	80164	Keithley Instruments, Inc. Cleveland, Ohio
		84411	Good-All Electric Mfg. Co. Ogallala, Nebr.
		91802	Industrial Devices, Inc. Edgewater, N. J.

TABLE 9. Code List of Suggested Manufacturers. (Based on Federal Supply Code for Manufacturers, Cataloging Handbook H4-1.)



NOTE:

1) ALL RESISTANCE AND CAPACITANCE SHALL BE DESIGNATED IN OHMS AND MICROFARADS RESPECTIVELY, UNLESS OTHERWISE NOTED.
2) ○ FRONT PANEL CONTROL
3) ⊘ FRONT PANEL SCREWDRIVER ADJ.
4) ⊘ REAR PANEL SCREWDRIVER ADJ.
5) ⊘ INTERNAL SCREWDRIVER ADJ.
6) / C.W. ROTATION M- MEGOHMS
7) P- PICOFARADS K- 1000 OHMS
8) * INDICATES NOMINAL VALUE ADJUSTED AT FACTORY.

PRELIMINARY COPY

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED: FRAC ±1/64, DEC .005, ANG ±1°

DRN 10-26-64 DATE 5/3/65
CHD MF DATE 7/10/65
ENG APPR R.C.K DATE 11-24-64
PLOT RELEASE DATE
RELEASE DATE

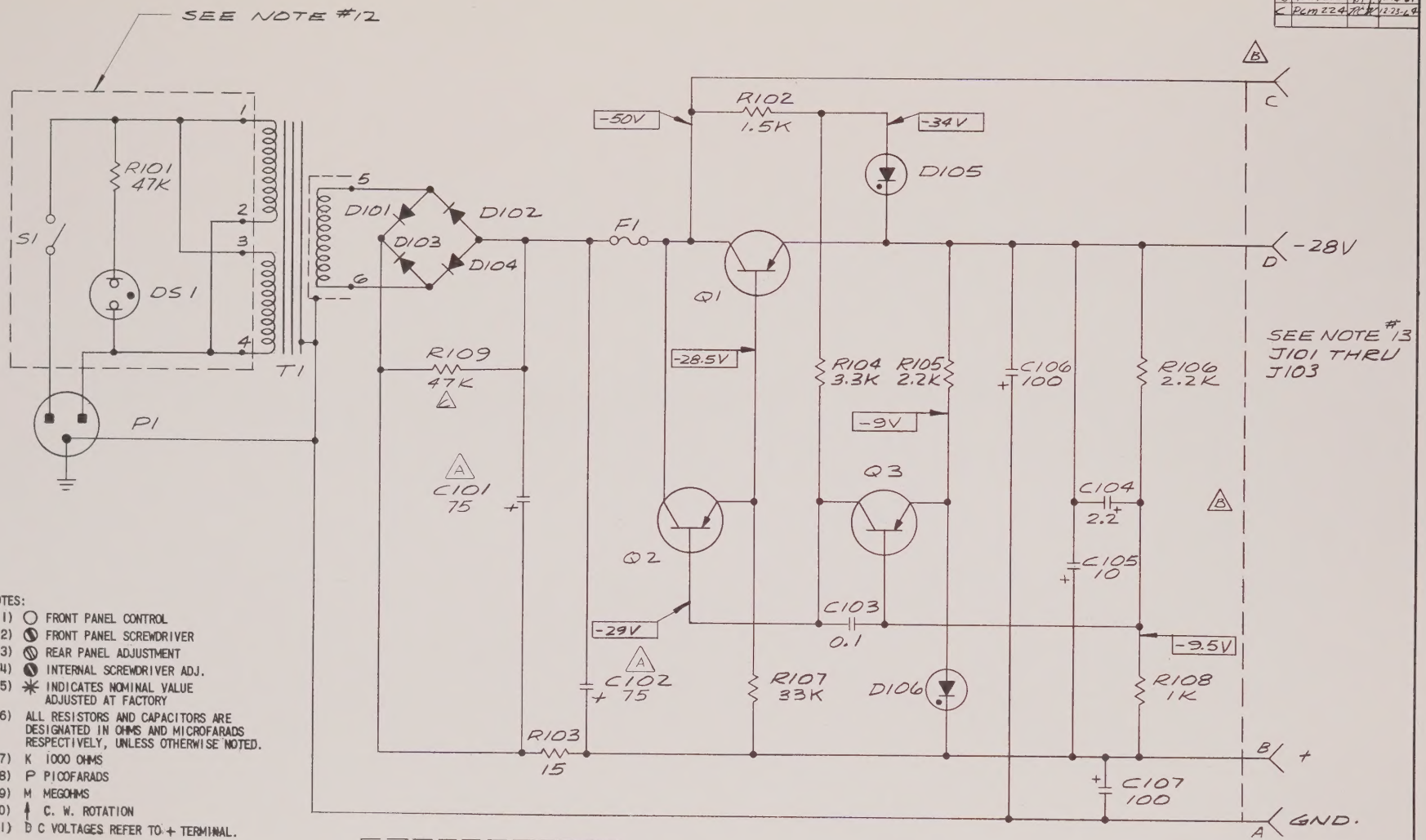
DO NOT SCALE

KEITHLEY INSTRUMENTS CLEVELAND OHIO

TITLE: SCHEMATIC AMPLIFIER

PART NUMBER 18739D

NEXT ASSY USED ON



REVISIONS			
LTR	ECO No.	APPR	DATE
A	PCM 118	MM	11-6-64
B	PCM 216	KS	1-14-65
C	PCM 224	MM	1-23-65

NOTES:

1) ○ FRONT PANEL CONTROL
2) ⊘ FRONT PANEL SCREWDRIVER
3) ⊘ REAR PANEL ADJUSTMENT
4) ⊘ INTERNAL SCREWDRIVER ADJ.
5) ✳ INDICATES NOMINAL VALUE ADJUSTED AT FACTORY
6) ALL RESISTORS AND CAPACITORS ARE DESIGNATED IN OHMS AND MICROFARADS RESPECTIVELY, UNLESS OTHERWISE NOTED.
7) K 1000 OHMS
8) P PICOFARADS
9) M MEGOHMS
10) ↺ C. W. ROTATION
11) D C VOLTAGES REFER TO + TERMINAL.
12) 117V CONNECTION IS SHOWN ABOVE-SEE BELOW FOR 234V CONNECTION.
13) NOTE 3 IDENTICAL OUTPUT CONNECTORS ARE USED- J101, J102, J103.

Q3	F1						
R109	C107	D106	DS1	S1	T1	P1	

HIGEST REF. DESIGNATION USED | REF. DESIGNATION NOT USED

1091	1
MODEL	NEXT ASSEMBLY USED ON / QUAN.

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED			DRN.	M.F.	DATE 7-8-64
FRAC.	DEC.	ANG.	CKD.		DATE
± 1/64	± .005	± 1°	ENG. APPR.		DATE
			PILOT RELEASE		DATE
DO NOT SCALE			PROD. RELEASE		DATE

KEITHLEY INSTRUMENTS CLEVELAND, OHIO

TITLE SCHEMATIC, POWER SUPPLY

MATERIAL

FINISH

PART NUMBER 17966C

KEITHLEY INSTRUMENTS, INC.
12415 EUCLID AVENUE CLEVELAND, OHIO 44106